Practitioner's Docket No. MCA-437 PC/US

CHAPTER II

Preliminary Classification:
Proprosed Class:
Subclass:

NOTE: "All applicants are requested to include a preliminary classification on newly filed patent applications. The preliminary classification, preferably class and subclass designations, should be identified in the upper right-hand corner of the letter of transmittal accompanying the application papers, for example 'Proposed Class 2, subclass 129.' " M.P.E.P. Section 601, 7th ed.

TRANSMITTAL LETTER TO THE UNITED STATES ELECTED OFFICE (EO/US)

(ENTRY INTO U.S. NATIONAL PHASE UNDER CHAPTER II)

PCT/US00/02423	28 January 2000	60/117,762	29 January 1999
INTERNATIONAL APPLICATION NO.	INTERNATIONAL FILING DATE	PRIORITY	DATE CLAIMED

PERFLUORINATED THERMOPLASTIC FILTER CARTRIDGE
TITLE OF INVENTION

Kwok-Shun CHENG, Cha P. DOH, Larry Y. YEN, Ranjikant B. PATEL and T. Dean GATES
APPLICANT(S)

CERTIFICATION UNDER 37 C.F.R. SECTION 1.10*
*(Express Mail label number is **mandatory**.)*
(Express Mail certification is optional.)

I hereby certify that this correspondence and the documents referred to as attached therein are being deposited with the United States Postal Service on this date July 27, 2001, in an envelope as "Express Mail Post Office to Addressee," Mail Label Number ET683704063US, addressed to the: Assistant Commissioner for Patents, Washington, D.C. 20231.

Noreen Buckley
(type or print name of person mailing paper)

Noreen Buckley
Signature of person mailing paper

WARNING: *Certificate of mailing (first class) or facsimile transmission procedures of 37 C.F.R. Section 1.8 cannot be used to obtain a date of mailing or transmission for this correspondence.*

***WARNING:** *Each paper or fee filed by "Express Mail" **must** have the number of the "Express Mail" mailing label placed thereon prior to mailing. 37 C.F.R. Section 1 10(b).*
*"Since the filing of correspondence under [Section] 1.10 without the Express Mail mailing label thereon is an oversight that can be avoided by the exercise of reasonable care, requests for waiver of this requirement will **not** be granted on petition.' Notice of Oct. 24, 1996, 60 Fed. Reg. 56,439, at 56,442.*

Box PCT
Assistant Commissioner for Patents
Washington D.C. 20231
ATTENTION: EO/US

NOTE: To avoid abandonment of the application, the applicant shall furnish to the USPTO, not later than 20 months from the priority date: (1) a copy of the international application, unless it has been previously communicated by the International Bureau or unless it was originally filed in the USPTO; and (2) the basic national fee (see 37 C.F.R. Section 1.492(a)). The 30-month time limit may not be extended. 37 C.F.R. Section 1.495

WARNING: *Where the items are those which can be submitted to complete the entry of the international application into the national phase are subsequent to 30 months from the priority date the application is still considered to be in the international state and if mailing procedures are utilized to obtain a date the express mail procedure of 37 C.F.R. Section1.10 must be used (since international application papers are not covered by an ordinary certificate of mailing - See 37 C.F.R. Section 1.8.*

NOTE: Documents and fees must be clearly identified as a submission to enter the national state under 35 USC 371 otherwise the submission will be considered as being made under 35 U.S.C. Section 111. 37 C.F.R. Section 1.494(f).

1. Applicant herewith submits to the United States Elected Office (EO/US) the following items under 35 U.S.C. 371:

   a. [X] This express request to immediately begin national examination procedures (35 U.S.C. Section 371(f)).

   b. [X] The U.S. National Fee (35 U.S.C. Section 371(c)(1)) and other fees (37 C.F.R. Section 1.492) as indicated below:

2.Fees

CLAIMS FEE	(1) FOR	(2) NUMBER FILED	(3) NUMBER EXTRA	(4) RATE	(5) CALCULATIONS
[ ]*	TOTAL CLAIMS	41- 20 =	21	x $ 18.00 =	$378.00
	INDEPENDENT CLAIMS	7- 3 =	4	x $ 80.00 =	$320.00
	MULTIPLE DEPENDENT CLAIM(S) (if applicable) + $270.00				$270.00
BASIC FEE**	[ ] U.S. PTO WAS INTERNATIONAL PRELIMINARY EXAMINATION AUTHORITY Where an International preliminary examination fee as set forth in Section 1.482 has been paid on the international application to the U.S. PTO: [ ] and the international preliminary examination report states that the criteria of novelty, inventive step (non-obviousness) and industrial activity, as defined in PCT Article 33(2) to (4) have been satisfied for all the claims presented in the application entering the national stage (37 C.F.R. Section 1.492(a)(4)) ..... $100.00 [ ] and the above requirements are not met (37 C.F.R. Section 1.492(a)(1)) ..... $690.00 [X] U.S. PTO WAS NOT INTERNATIONAL PRELIMINARY EXAMINATION AUTHORITY Where no international preliminary examination fee as set forth in Section 1.482 has been paid to the U.S. PTO, and payment of an international search fee as set forth in Section 1.445(a)(2) to the U.S. PTO: [ ] has been paid (37 C.F.R. 1.492(a)(2)) ..... $710.00 [ ] has not been paid (37 C.F.R. 1.492(a)(3)) ..... $1,000.00 [X] where a search report on the international application has been prepared by the European Patent Office or the Japanese Patent Office (37 C.F.R. Section 1.492(a)(5)) $860.00				$860.00
	Total of above Calculations				=$1,828.00
SMALL ENTITY	Reduction by 1/2 for filing by small entity, if applicable. Affidavit must be filed. (note 37 C.F.R. Sections 1.9, 1.27, 1.28)				-
	Subtotal				
	Total National Fee				$1,828.00
	Fee for recording the enclosed assignment document $40.00 (37 C.F.R. 1.21(h)). (See Item 13 below). See attached "ASSIGNMENT COVER SHEET".				$ 40.00
TOTAL	Total Fees enclosed				$1,868.00

* See attached Preliminary Amendment Reducing the Number of Claims.

i. [ ] A check in the amount of $_____ to cover the above fees is enclosed.
ii. [X] Please charge Account No. 501-908 in the amount of $ $1,868.00.
A duplicate copy of this sheet is enclosed.

** *WARNING:* *"To avoid abandonment of the application the applicant shall furnish to the United States Patent and Trademark Office not later than the expiration of 30 months from the priority date: * * * (2) the basic national fee (see Section 1.492(a)). The 30-month time limit may not be extended." 37 C.F.R. Section 1.495(b).*

WARNING: *If the translation of the international application and/or the oath or declaration have not been submitted by the applicant within thirty (30) months from the priority date, such requirements may be met within a time period set by the Office. 37 C.F.R. Section 1.495(b)(2). The payment of the surcharge set forth in Section 1.492(e) is required as a condition for accepting the oath or declaration later than thirty (30) months after the priority date. The payment of the processing fee set forth in Section 1.492(f) is required for acceptance of an English translation later than thirty (30) months after the priority date. Failure to comply with these requirements will result in abandonment of the application. The provisions of Section 1.136 apply to the period which is set. Notice of Jan. 3, 1993, 1147 O.G. 29 to 40.*

3. [X] A copy of the International application as filed (35 U.S.C. Section 371(c)(2)):

NOTE: *Section 1.495 (b) was amended to require that the basic national fee and a copy of the international application must be filed with the Office by 30 months from the priority date to avoid abandonment "The International Bureau normally provides the copy of the international application to the Office in accordance with PCT Article 20. At the same time, the International Bureau notifies applicant of the communication to the Office. In accordance with PCT Rule 47.1, that notice shall be accepted by all designated offices as conclusive evidence that the communication has duly taken place. Thus, if the applicant desires to enter the national stage, the applicant normally need only check to be sure the notice from the International Bureau has been received and then pay the basic national fee by 30 months from the priority date." Notice of Jan. 7, 1993, 1147 O.G. 29 to 40, at 35-36. See item 14c below.*

a. [ ] is transmitted herewith.
b. [ ] is not required, as the application was filed with the United States Receiving Office.
c. [X] has been transmitted
i. [X] by the International Bureau.
Date of mailing of the application (from form PCT/IB/308): 03 August 2000.
ii. [ ] by applicant on _____.
Date

4. [X] A translation of the International application into the English language (35 U.S.C. Section 371(c)(2)):
a. [ ] is transmitted herewith.
b. [X] is not required as the application was filed in English.
c. [ ] was previously transmitted by applicant on _____.
Date
d. [ ] will follow.

5. [X] Amendments to the claims of the International application under PCT Article 19 (35 U.S.C. Section 371(c)(3)):

NOTE: The Notice of January 7, 1993 points out that 37 C.F.R. Section 1.495(a) was amended to clarify the existing and continuing practice that PCT Article 19 amendments must be submitted by 30 months from the priority date and this deadline may not be extended. The Notice further advises that: "The failure to do so will not result in loss of the subject matter of the PCT Article 19 amendments. Applicant may submit that subject matter in a preliminary amendment filed under Section 1.121. In many cases, filing an amendment under Section 1.121 is preferable since grammatical or idiomatic errors may be corrected." 1147 O.G. 29-40, at 36.

a. [ ] are transmitted herewith.
b. [ ] have been transmitted
   i. [ ] by the International Bureau.
   Date of mailing of the amendment (from form PCT/IB/308): _____.
   ii. [ ] by applicant on _____.
   Date
c. [X] have not been transmitted as
   i. [X] applicant chose not to make amendments under PCT Article 19.
   Date of mailing of Search Report (from form PCT/ISA/210): 17 July 2000.
   ii. [ ] the time limit for the submission of amendments has not yet expired. The amendments or a statement that amendments have not been made will be transmitted before the expiration of the time limit under PCT Rule 46.1.

6. [X] A translation of the amendments to the claims under PCT Article 19 (38 U.S.C. Section 371(c)(3)):
a. [ ] is transmitted herewith.
b. [ ] is not required as the amendments were made in the English language.
c. [X] has not been transmitted for reasons indicated at point 5(c) above.

7. [X] A copy of the international examination report (PCT/IPEA/409)
[X] is transmitted herewith.
[ ] is not required as the application was filed with the United States Receiving Office.

8. [ ] Annex(es) to the international preliminary examination report
a. [ ] is/are transmitted herewith.
b. [ ] is/are not required as the application was filed with the United States Receiving Office.

9. [ ] A translation of the annexes to the international preliminary examination report
a. [ ] is transmitted herewith.
b. [ ] is not required as the annexes are in the English language.

10. [X] An oath or declaration of the inventor (35 U.S.C. Section 371(c)(4)) complying with 35 U.S.C. 115

a. [ ] was previously submitted by applicant on _____.
Date

b. [X] is submitted herewith, and such oath or declaration

i. [ ] is attached to the application.

ii. [X] identifies the application and any amendments under PCT Article 19 that were transmitted as stated in points 3(b) or 3(c) and 5(b); and states that they were reviewed by the inventor as required by 37 C.F.R. Section 1.70.

c. [ ] will follow.

Other document(s) or information included:

11. [X] An International Search Report (PCT/ISA/210) or Declaration under PCT Article 17(2)(a):

a. [X] is transmitted herewith.

b. [ ] has been transmitted by the International Bureau.
Date of mailing (from form PCT/IB/308): _____.

c. [ ] is not required, as the application was searched by the United States International Searching Authority.

d. [ ] will be transmitted promptly upon request.

e. [ ] has been submitted by applicant on _____.
Date

12. [X] An Information Disclosure Statement under 37 C.F.R. Sections 1.97 and 1.98:

a. [ ] is transmitted herewith.
Also transmitted herewith is/are:
[ ] Form PTO-1449 (PTO/SB/08A and 08B).
[ ] Copies of citations listed.

b. [X] will be transmitted within THREE MONTHS of the date of submission of requirements under 35 U.S.C. Sections 371(c).

c. [ ] was previously submitted by applicant on _____.
Date

13. [X] An assignment document is transmitted herewith for recording.

A separate [ ] "COVER SHEET FOR ASSIGNMENT (DOCUMENT) ACCOMPANYING NEW PATENT APPLICATION" or[X] FORM PTO 1595 is also attached.

_____
_____
_____

14. [ ] Additional documents:
    a. [ ] Copy of request (PCT/RO/101)
    b. [X] International Publication No. WO 00/44485
        i. [X] Specification, claims and drawing
        ii. [ ] Front page only
    c. [ ] Preliminary amendment (37 C.F.R. Section 1.121)
    d. [ ] Other

_____
_____
_____

15. [ ] The above checked items are being transmitted
    a. [ ] before 30 months from any claimed priority date.
    b. [ ] after 30 months.

16. [ ] Certain requirements under 35 U.S.C. 371 were previously submitted by the applicant on _____, namely:

_____
_____
_____

AUTHORIZATION TO CHARGE ADDITIONAL FEES

WARNING: *Accurately count claims, especially multiple dependent claims, to avoid unexpected high charges if extra claims are authorized.*

NOTE: "A written request may be submitted in an application that is an authorization to treat any concurrent or future reply, requiring a petition for an extension of time under this paragraph for its timely submission, as incorporating a petition for extension of time for the appropriate length of time. An authorization to charge all required fees, fees under Section 1.17, or all required extension of time fees will be treated as a constructive petition for an extension of time in any concurrent or future reply requiring a petition for an extension of time under this paragraph for its timely submission. Submission of the fee set forth in Section 1.17(a) will also be treated as a constructive petition for an extension of time in any concurrent reply requiring a petition for an extension of time under this paragraph for its timely submission." 37 C.F.R. Section 1.136(a)(3)

NOTE: "Amounts of twenty-five dollars or less will not be returned unless specifically requested within a reasonable time, nor will the payer be notified of such amounts; amounts over twenty-five dollars may be returned by check or, if requested, by credit to a deposit account." 37 C.F.R. Section 1.26(a).

[X The Commissioner is hereby authorized to charge the following additional fees that may be required by this paper and during the entire pendency of this application to Account No. 501-908.

[X] 37 C.F.R. Section 1.492(a)(1), (2), (3), and (4) (filing fees)

WARNING: *Because failure to pay the national fee within 30 months without extension (37 C.F.R. Section 1.495(b)(2)) results in abandonment of the application, it would be best to always check the above box.*

[X] 37 C.F.R. Section 1.492(b), (c) and (d) (presentation of extra claims)

NOTE: *Because additional fees for excess or multiple dependent claims not paid on filing or on later presentation must only be paid or these claims cancelled by amendment prior to the expiration of the time period set for response by the PTO in any notice of fee deficiency (37 C.F.R Section 1.492(d)), it might be best not to authorize the PTO to charge additional claim fees, except possible when dealing with amendments after final action.*

[X] 37 C.F.R. Section 1.17 (application processing fees)
[X] 37 C.F.R. Section 1.17(a)(1)-(5)(extension fees pursuant to Section 1.136(a).
[ ] 37 C.F.R. Section 1.18 (issue fee at or before mailing of Notice of Allowance, pursuant to 37 C.F.R. Section 1.311(b))

NOTE: *Where an authorization to charge the issue fee to a deposit account has been filed before the mailing of a Notice of Allowance, the issue fee will be automatically charged to the deposit account at the time of mailing the notice of allowance. 37 C.F.R. Section 1.311(b).*

NOTE: *37 C.F.R. 1.28(b) requires "Notification of any change in loss of entitlement to small entity status must be filed in the application . . . prior to paying, or at the time of paying . . . issue fee." From the wording of 37 C.F.R. Section 1.28(b): (a) notification of change of status must be made even if the fee is paid as "other than a small entity" and (b) no notification is required if the change is to another small entity.*

[ ] 37 C.F.R. Section 1.492(e) and (f) (surcharge fees for filing the declaration and/or filing an English translation of an International Application later than 30 months after the priority date).

SIGNATURE OF PRACTITIONER

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29621
PATENT TRADEMARK OFFIC

Practitioner's Docket No. MCA-437 PC/US **PATENT**

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of: Kwok-Shun CHENG, et al.
Application No.: 0 /
Filed: herewith
For: PERFLUORINATED THERMOPLASTIC FILTER CARTRIDGE

Group No.:
Examiner:

Assistant Commissioner for Patents
Washington, D.C. 20231

EXPRESS MAIL CERTIFICATE

"Express Mail" label number ET683704063US
Date of Deposit July 27, 2001

I hereby state that the following *attached* paper or fee
Transmittal letter to the U.S. Elected Office (EO/US);
Duplicate of page 4 authorizing use of deposit account;
Copy of Published PCT application WO/44485;
Copy of International Preliminary Examination Report;
Copy of International Search Report w/references;
Executed Declaration and Power of Attorney;
Recordation Coversheet Form (x2); Executed Assignment;
Return Receipt Postcard.

is being deposited with the United States Postal Service "Express Mail Post Office to Addressee" service under 37 C.F.R. § 1.10, on the date indicated above and is addressed to the Assistant Commissioner for Patents, Washington, D.C. 20231.

Noreen Buckley
Typed or printed name of person mailing paper or fee

Noreen Buckley
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NOTE: The label number need not be placed on each page. It should, however, be placed on the first page of each separate document, such as, a new application, amendment, assignment, and transmittal letter for a fee, along with the certificate of mailing by "Express Mail." Although the label number may be on checks, such a practice is not required. In order not to deface formal drawings it is suggested that the label number be placed on the back of each formal drawing or the drawings be accompanied by a set of informal drawings on which the label number is placed.

(Express Mail Certificate [8-3])

Perfluorinated Thermoplastic Filter Cartridge

This invention relates to a filter cartridge that is formed of one or more perfluorinated thermoplastic resins. Moreover, this invention relates to a filter cartridge that is formed of one or more perfluorinated thermoplastic resins, wherein the filter element is a flat sheet membrane which may be configured in various ways or a plurality of hollow fiber membranes or a depth filter.

Background Of The Invention

Filtration cartridges are well known devices used in many applications to separate substances such as particles, microorganisms, dissolved species, etc. from their carrier fluid. These cartridges are formed of one or more filtration membranes, either in the form of a flat sheet or in the form of hollow fibers, which are secured within a housing. Cartridges are configured so that the fluid to be filtered enters through an inlet, passes through the membrane filter, and the filtered fluid exits through an outlet. In some configurations, a portion of the entering fluid is removed through a second outlet as a concentrated stream. The membrane(s) provide a semi-permeable barrier that separates the inlet from the outlet so as to achieve filtration.

Filter cartridges are comprised of a membrane filter, a housing in which the filter is located and fluid-tight seals. Membrane filters are porous structures having average pore sizes of from about 0.005 micron to about 10 micron. Membranes with average pore size of from about 0.002 to about 0.05 micron are generally classified as ultrafiltration membranes. Ultrafiltration membranes are used to separate proteins and other macromolecules from aqueous solutions. Ultrafiltration membranes are usually rated in terms of the size of the solute they will retain. Typically, ultrafiltration membranes can be produced to retain dissolved or dispersed solutes of from about 1000 Daltons to about 1,000,000 Daltons. They can be rated by Molecular Weight Cutoff, which is the molecular weight expressed in Daltons, a unit of molecular mass, at which a stated per cent of the feed concentration of the solute being processed is retained or rejected by the membrane. Manufacturers usually set the stated per cent at 90% to 95%. Membranes with pore sizes of from about 0.05 to 10 microns are

pores represent a minor faction of the surface area. An unskinned membrane will be porous over the major portion of the surface. The porosity may be comprised of single pores or areas of porosity. Porosity here refers to surface porosity, which is defined as the ratio of surface area comprised of the pore openings to the total frontal surface area of the membrane. Microporous membranes may be classified as symmetric or asymmetric, referring to the uniformity of the pore size across the thickness of the membrane. In the case of a hollow fiber, this is the porous wall of the fiber. Symmetric membranes have essentially uniform pore size across the membrane cross-section. Asymmetric membranes have a structure in which the pore size is a function of location through the cross-section. Another manner of defining asymmetry is the ratio of pore sizes on one surface to those on the opposite surface.

The housing is usually a hollow cylinder, although other shapes are known. For ease of discussion, and not to be a limitation, cylindrical filters are discussed, although practitioners will be able to use the teachings and descriptions for other shapes. The membrane filter is located or placed within the housing. The housing serves to protect the membrane, to act as a pressure container in some cases, and to provide inlet and outlet ports or other connections for fluid flow to enter, exit, and contact the membrane filter in a controlled way.

In a practical filtration, the inlet stream is isolated from the filtered outlet stream. The filter cartridge membrane is formed and placed in the cartridge so that only one surface of the membrane contacts the inlet fluid, and the other membrane surface only contacts the filtered fluid that has passed through the membrane filter. This requires a seal to prevent the inlet fluid stream from bypassing the membrane to the outlet stream. The seal also can have provisions to allow the fluid passing through the membrane to exit the cartridge, or to serve as an inlet for fluid to be filtered to contact the membrane.

Fabricating a useful seal presents difficult problems. The seal material has to be chemically and thermally stable for the application in which the cartridge will see duty. For applications where perfluorinated membrane filters are beneficial, a sealing material of lesser properties would prevent full utility of the cartridge. The sealing material must bond well to the membrane filter, otherwise leakage can occur through the membrane-seal interface. In many cartridge designs, the seal and the cartridge housing must be bonded together liquid-tightly for the same reasons. Thermal bonding is a preferred method since it provides bonding on a molecular level, and does not require additional materials.

For hollow fiber membrane cartridges, fiber is cut or otherwise made to a specific length and a number of fibers gathered into a bundle. A portion of one or both ends of the fiber

Manufacturers fabricate filter cartridges from various polymeric materials. Commonly, cartridges are made of polyolefins, polysulfone polymers, polyamides and other such well-known materials.

In the area of microelectronics, such as in the fabrication of semiconductors, such common polymeric materials cannot be used, as the conditions of production, namely highly acidic and oxidative chemicals or solvents used at high temperatures tend to dissolve or weaken most common polymeric materials. For this reason, fluorinated polymers, in particular poly (tetrafluoroethylene) (PTFE), being more chemically and thermally stable, are used. PTFE materials are the preferred materials of choice in that they are inert, capable of withstanding high temperatures and tend to have extremely low levels of extractables. However, the problems with manufacturing PTFE based cartridges are legendary. Not being thermoplastic, extreme processing parameters are required to fabricate PTFE into complex molded shapes. Additionally, PTFE materials do not tend to bond easily to any other materials including themselves.

Fluoropolymers can be placed into two general classes; those made from perfluorocarbon monomers and those made from monomers with hydrogen, chlorine, or both, and sufficient fluorine to contribute significantly to the resulting polymer properties. Perfluorinated polymers include poly (tetrafluoroethylene) (PTFE), poly (tetrafluoroethylene-co-hexafluoropropylene) (FEP), and poly (tetrafluoroethylene-co-perfluoro (alkylvinyl ether)) (PFA). The second class includes poly (ethylene-co- tetrafluoroethylene) (ETFE), poly (chlorotrifluoroethylene) (CTFE), poly (chlorotrifluoroethylene-co-ethylene) (ECTFE). Polyvinylidene fluoride (PVDF) and polyvinyl fluoride (PVF) are sometimes included in the second class.

PTFE does not flow and cannot be fabricated by conventional techniques that require manipulating molten polymer. Fabricators have developed innovative processing technologies, similar to modified powder metallurgy methods, in order to utilize this polymer. FEP and PFA polymers were developed to meet the need for perfluorinated polymers that had chemical and thermal stability close to PTFE, but had the advantages of being melt processable. Plastic fabricators are able to produce a wide variety of products, such as films, extruded tubing, valves, and intricate molded parts with PFA and FEP by high-speed extrusion, injection molding and blow molding methods. PFA also has better creep resistance than PTFE, which is important for products under constant compressive or tensile load.

Polymers of the second class do not have the chemical or thermal stability of FEP and particularly of PFA types. ETFE has an upper use temperature of about 150°C and is affected

US Patent 4,154,688 suggests fusing a pleated membrane cylinder to an end cap of PTFE, but states that this would be difficult, and given that PTFE is not fluid even above its melting point, PTFE would not serve as a suitable bonding agent.

US Patent 4,609,465 provides a filtering apparatus for removing particulates from destructive fluids. In accordance with the invention, all components of the filtering apparatus are fabricated from a fluoropolymer. These are defined as any fluorine-containing polymer, including perfluoropolymers, which are highly resistant to the deteriorative effects of destructive fluids, such as acids and/or solvents. No advantages are taught that would enable a practitioner to choose between perfluorinated thermoplastics and other fluoropolymers, such as PVDF, a preferred embodiment of the invention. PVDF is known to be soluble in aprotic solvents such as dimethylacetamide, and swollen by other solvents, such as some esters, and is therefore not suitable for uses in many applications requiring solvent resistance. Moreover, the invention of 4,609,465 requires a sealing ring cooperatively arranged with an end cap, with at least the surface of the sealing ring comprising a fluoropolymeric material. Such an arrangement will not provide as integral a seal under severe conditions as a thermally bonded seal.

US Patents 5,066,397 and 4,980,060 provide for hollow fiber filter elements comprising a plurality of porous hollow fiber membranes of a thermoplastic resin, each of which membranes has two end portions, at least one of said end portions of said membranes being directly fusion bonded at its periphery to form a unified terminal block in which the end portions of said membranes are fluid-tightly bonded to each other in a fused fashion. In 4,980,060, the membranes are fusion bonded through a thermoplastic resin medium to form a unified terminal block structure in which the end portions of said membranes are fluid-tightly bonded together in a fused fashion. It is evident that a key element in these inventions is the fusion of the individual fibers into a single end structure. Even in 4,980,060, the thermoplastic resin medium is only a minor fraction of the end structure as described in the disclosure. Therefore the strength of the end structure is dependent on the uniformity of the fiber-to-fiber fusion, and is dependent on the physical properties of the fiber material. Moreover, by fusing the hollow fiber membranes together, the structure of individual fibers can be compromised, with possible deleterious effects. The spaces between fibers made of polymers having high viscosity in the melt, such as perfluorinated thermoplastics, would generate bubbles during the fusion. Such bubbles would be very difficult to remove and would be sources of weakness. Therefore, a filter cartridge that had the individual fibers bonded to the end seal material would have a more

provides one with the capability of various modifications and complex designs which are not available with PTFE products today. The present invention provides such a device.

Summary Of The Invention

In a first embodiment, the present invention provides for a filter cartridge comprising a housing with a first and a second end, a membrane filter having two surfaces with a porous wall between, with two ends within the housing, sealing means to seal each end of the membrane filter into a shaped form, so that a sealed membrane end is within the housing at or near the first end of the housing and the seal of the other end of the membrane filter is at or near the second end of the housing. Inlet and outlet means are provide to allow a fluid containing a substance to be filtered to enter the housing and contact one surface of the membrane, whereby the fluid will pass through the membrane filter and become separated from a portion of the filtered substance, and the fluid passing through the membrane filter will exit the outlet means.

In a further embodiment, the membrane filter of the first embodiment is a pleated flat sheet membrane.

In a second embodiment, the present invention provides for a filter cartridge comprising a housing with a first and a second end, a membrane filter having two surfaces with a porous wall between, with two ends within the housing, sealing means to seal each end of the membrane filter into a shaped form, so that a sealed membrane end is within the housing at or near the first end of the housing and the seal of the other end of the membrane filter is at or near the second end of the housing. The membrane filter comprises a plurality of hollow fiber membranes having an outer diameter and an inner diameter. The housing has at least one fluid inlet or outlet means. The inner diameters of the fibers are open to fluid flow passing from outside the housing to the inside of the housing across the fiber seal, whereby the fluid will pass through the membrane filter and become separated from a portion of the filtered substance, and the fluid passing through the membrane filter will exit housing through the outlet means of the housing.

In a version of the second embodiment, the fibers at both ends of the cartridge are open to fluid flow.

Detailed Description Of The Invention

This invention provides a perfluorinated thermoplastic resin filter cartridge. The advantages of such a device are many. Perfluorinated thermoplastic resins inherently have a high degree of chemical and temperature resistance and have very low amounts of extractable matter, making their use for ultrapure filtration a desirable advantage. Lastly, as they are thermoplastic, membranes and components can be easily formed and bonded together. In essence, these polymers provide all of the advantages of PTFE resins without their disadvantages.

Filter cartridges are comprised of a membrane filter, a housing in which the filter is located and fluid-tight seals. In the present invention, the potting or sealing material which bonds the membrane in whatever form it may be, and the membrane or membranes are formed of perfluorinated thermoplastic resins. The housing is preferably made of perfluorinated thermoplastic resin, although PTFE may be used. The remainder of the elements are formed of perfluorinated thermoplastic resins.

In Figure 1 is shown a preferred embodiment of the present invention for a pleated sheet membrane. The perfluorinated thermoplastic filter membrane is made as described in US Patents 4,902,456, 4,906,377, 4,990,294, and 5,032,274. In the usual procedure, the membrane is placed between permeable fabric supporters in a sandwich form and folded into pleats. The upstream and downstream supports also provide drainage for the membrane. Suitable supports are non-woven or woven fabrics, formed nets, knitted fabrics, and punched sheets or similar webs. These are preferably made from perfluorinated thermoplastics resins. The pleated membrane sandwich is formed into a cylinder having two ends, with the pleats running axially, and the two axial ends of the pleated sandwich are bonded together by a combination of heat and pressure.

The housing 10, which may be as in this instance a cylindrical tube, although other shapes and configurations may be used, has inlets 20 and an outlet 30 with a membrane 40, in this instance a pleated flat sheet membrane 40, contained within the housing 10 between the inlet 20 and the outlet 30. The cartridge may have outlets on one or both ends. The membrane 40 is sealed in such a manner that all fluid entering the inlets 20 must pass through the

sandwich may extend a short length pass the end of the housing or may be of equal length as the housing. A similar process is then conducted at the other end of the housing/pleated membrane sandwich cylinder.

The sealing means and the membrane 40 are formed of one or more perfluorinated, thermoplastic resins. Preferably, each of the elements of the device is preferably formed from one or more perfluorinated thermoplastic resins.

The membrane may also be in the form of one or more hollow fibers. Perfluorinated thermoplastic hollow fibers and their method of making are taught in US Patent Applications 60/117,852 and 60/117,854, filed January 29, 1999 and US Patents 4,902,456, 4,906,377, 4,990,294, and 5,032,274, all of which are incorporated herein in their entireties.

The housing and the selection and arrangement of the membrane within the housing is a matter of design and is well known to one of ordinary skill in the art. In the usual case, a bundle of a plurality of hollow fiber membranes having two ends is fluid tightly sealed or potted in at least one end. The potted end or ends is cut perpendicularly to the fiber direction or otherwise trimmed to open the fibers for fluid flow.

Practitioners use several methods to form hollow fiber membrane cartridges. In one case, a bundle of a plurality of hollow fiber membranes would be potted with the fibers oriented more or less parallel to the housing axis and each end of the bundle potted. Either or both potted ends would be cut and opened, depending on the cartridge design and application. In other cases, the fiber bundle is made into a looped arrangement. This can be a simple folded-over single loop, or more complex cross wound type structures that are freestanding. The single loop is usually potted at the non-looped end, although some practitioners will pot the looped end for stability in use. The wound structures can be potted at one or both ends. In some cases, the wound structure is cut in half before potting to form two looped structures, each of which is potted at the cut ends.

A cartridge similar to those shown in Figures 1 and 2 could be envisioned by one skilled in the art for what is usually termed "dead end" filtration. The practitioner would substitute a potted fiber bundle for the pleated membrane filter sandwich. These could be used with either the feed stream fluid to be filtered contacting the outside surface of the membranes and the filtered fluid recovered from the lumen of the fibers, or the feed stream could be fed to the lumen of the hollow fiber membranes and the filtered fluid recovered form the outer surface of the fibers.

Regardless of the selection of fibers and or combinations with other filters, the core 42 of the filter is attached to the outlet 43 in such a manner so as to form a fluid tight seal between the core 42 and the outlet 43. Additionally, the top 44 of the depth filter is sealed by a closed end cap 45 so as to form a liquid tight seal .In this manner, fluid must pass through the membrane 41 a and b into the core 42 and then through the outlet 43. The central core 42 may be attached to the outlet by O-rings, mechanical threads or other such mechanical equivalents or by a thermal bonding between the core 42 and the outlet 43. The thermal bonding method is preferred. More preferably, the thermal bonding is achieved by the use of perfluorinated, thermoplastic resins for both the core and the end cab 45B. The bonding may occur through the use of additional resin that seals the two components together or alternatively, they may be directly bonded to each other, using such means as ultrasonic welding, convection heating and other such well-known means in the art. The filter may then be placed in a housing with the outlet 43 being sealed to the housing outlet by a ny conventional means such as O-rings 46 as shown in the drawing or threaded fixtures, friction fitting or a chemical or thermal bond.

Figure 5 shows another preferred embodiment of the present invention. This embodiment and its method of making is taught in U.S. Patent 5, 762, 789, the teachings of which are incorporated herein in their entireties. The device is designed for low volume holdup filtration device. It has a housing 50, an end cap 51 with a vent 52, inlet 53 and outlet 54 and a membrane 55, either formed of a flat sheet or as a bundle of hollow fibers(as shown). The inlet 53 is directed from the top of the end cap 51 to the bottom 56 of the housing 50 wherein the fluid traveling through the inlet 53 then passes into the membrane which is sealed in a fluid tight arrangement such that all fluid from the inlet 53 which passes to the outlet 54 must pass through the membrane 55. In an alternative arrangement, the outlet 54 is located such that it is near the bottom of the housing 50 and travels to the top of the end cap 51. The inlet 53 is simply located within the end cap 51 and passes fluid to the membrane where it flows through to the outlet 54.

Regardless of the configuration of the filter, whether it uses a flat sheet, hollow fiber, depth style filter element or disk elements, a key to the invention is the formation of a liquid tight seal between the filter and the cartridge such that an integral filtration device is formed. The problem in the past has been how to accomplish this sealing without harming the membrane and insuring that the material selected for the sealing is identical or similar and compatible to the poly (TFE-co-PFAVE) resin used in making the membrane.

those which form the membrane and the sealing material. Preferably it is also formed of the same perfluorinated thermoplastic resin. Whether formed of the same resin or a compatible resin, it must have a melting point above that of the sealing material so as to allow for the melting of the sealing material within that component.

One such method for sealing the membrane is to select a sealing resin which has a melting point below that of the membrane and the end cap or caps. One may simply insert the membrane into one of the end caps and then flow the molten resin into the cap while maintaining the temperature above the melting point of the sealing resin in order to allow it to flow and completely encompass and seal the membrane within the cap. If desired, the opposite end of the membrane can then be similarly sealed within a separate cap. Alternatively, one may place the resin within the cap and elevate the temperature to a point above the melting point of the resin but below that of the cap. The membrane is then simply inserted into the molten sealing resin and the temperature is maintained for a period of time sufficient to allow for complete sealing of the membrane within the resin within the cap. In this embodiment, the resin may be solid when placed within the cap (e.g., it may be a powder inserted into the cap at room temperature) and then heated to a point above its melting point. Alternatively, the resin may be heated separately until it is molten, the cap is then heated and the molten resin is inserted into the cap. A further alternative is to simply insert the component such as the housing and membrane into the molten pool of sealing material in order to form the desired seal.

Of course with a flat sheet membrane which formed into a generally cylindrical shape, there is also often the need to seal the longitudinal seam between the two adjacent ends of the sheet. This may also be done through the use of a perfluorinated, thermoplastic resin that again has a peak melting point below that of the membrane. Typically, the membrane is either wrapped upon itself or around a core and the two adjacent ends either butt together or overlap each other by a suitable amount. In either case, the resin can be melted and applied along the two edges so as to seal the two edges together. Alternatively, the butted or overlapped axial ends can be thermally bonded by application of suitable heat and pressure.

The formation of a depth filter formed of perfluorinated thermoplastic resin may occur simply by extruding a fiber of molten perfluorinated resin onto a rotating mandrel such that the fibers bond to each other where they cross. Alternatively, the fiber may be pre formed and wound upon a core. The wound core is then heated to a temperature at or above the melting

ID and a wall thickness of about ¼". The housing ends were pretreated and fused with MFA 904AX powdered resin. A depression was made with a rod in the potting cup. The housing and the fiber bundle are inserted into the cavity and were left there for 2 days. The potted fiber bundle was retrieved carefully and the housing reversed to treat the other end. After both ends were potted, the potting was cut to expose the lumens. The potted surfaces were then polished with a heat gun to remove any loose resins. The module was tested for integrity with IPA. It was found that one fiber had a defect. A solder gun was used to repair the module to plug both ends of the fiber. The module was tested again and was integral.

After the potted ends were cooled, the bundle was removed and inspected. One could visually observe a number of voids and bubbles in the potting surrounding the fibers. Adhesion strength was excellent. The fibers could not be pulled out of the potting compound. Following inspection, excess fibers and tubing beyond the potted ends were trimmed off to be readied for post-extrusion heat treatment. One of the ends was then placed in a cylindrical cup-shaped metal holder with depth and diameter approximately the same dimensions as the potted end. The holder with the potted end was then fitted into a cutout in a metal heating block. The block was heated with electrical heating bands and its temperature was controlled at 280°C. The sample was heated for about one hour at that temperature. This procedure was repeated for the opposite end of the bundle. After completion of the post-extrusion heat treatment, the ends were machined to until the lumens of the fibers were exposed. The fibers were observed to be bonded together on their shell side by the potting resin and no visible voids were observed. Adhesion strength was the same as before the heating treatment.

Example 3

A container with dimensions of 57 millimeters (mm) diameter, 25 mm deep was partially filled with 45 grams of poly (tetrafluoroethylene-co-perfluoro (alkylvinylether)) having a melting temperature of 256°C and a melt index 373 at 5Kg, 373°C. The container was placed in an oven at 275°C for approximately 24 hours to produce a molten pool of the poly (tetrafluoroethylene-co-perfluoro (alkylvinylether)) in the container. A bundle of 30 hollow fiber membrane fibers was made. The fibers were 8centimeter long, with an outer diameter of 850microns, and a wall thickness of 225microns. The fibers were made from poly (tetrafluoroethylene-co-perfluoro (alkylvinylether)) having a melt temperature of approximately 285°C. The fiber bundle was tied near one end with a length of Teflon® pipe tape. The fibers were placed in a hollow cylinder made of poly (tetrafluoroethylene-co-perfluoro

fiber end sealing was done similar to the method of example 1. Isopropyl alcohol bubble point testing showed the filter element to be integral.

While the present invention has been described in regard to its preferred embodiments, other embodiments, alternatives and modifications of the present invention will be obvious to one of ordinary skill in the art and it is meant in the following claims to include such other embodiments, alternatives and modifications of the present invention.

What we claim:

7) The cartridge of claim 6 wherein the perfluorinated thermoplastic polymer is poly (tetrafluororethylene)-co- perfluoro (alkylvinylether)) and the alkyl is selected from the group consisting of propyl, methyl and blends of propyl and methyl.

8). The cartridge of claim 1 wherein the membrane is selected from the group consisting of hollow fibers, flat sheets and wound fibers.

9). The cartridge of claims 1,2, 3 and 4 further comprising one or more end caps for the housing wherein the end caps are formed of perfluorinated thermoplastic resin.

10). The cartridge of claim 1 wherein the membrane is in the form of a flat sheet, said flat sheet membranes being formed into a shape selected from the group consisting of pleats, spirals and discs.

11). The cartridge of claim 1 wherein the membrane is a depth filter formed of one or more wound fibers.

12). The cartridge of claim 1 wherein the membrane is formed of a series of hollow fiber membranes having at least one end of said fiber membranes potted in a block of perfluorinated thermoplastic resin.

13). A filter cartridge made substantially of perfluorinated thermoplastic polymers comprising;

a) a perfluorinated thermoplastic polymer housing having an inlet and an outlet for fluid flow,

b) a perfluorinated thermoplastic polymer membrane filter positioned in said housing to filter a fluid containing filterable substances, said filter interposed between a fluid entering said housing inlet and said fluid exiting said housing outlet after being filtered,

23). A filter cartridge made substantially of perfluorinated thermoplastic polymers, said filter cartridge comprising a cylindrical form and further comprising;

a) a perfluorinated thermoplastic polymer housing having two ends, having at least one fluid inlet ,

b) a cylindrical perfluorinated thermoplastic polymer membrane filter arrangement having a generally annular form and having two ends, said membrane filter positioned in said housing to filter a fluid containing filterable substances,

c) a perfluorinated thermoplastic polymer liquid tight seal at each end of said membrane filter, said seal encapsulating a portion of said each end of said membrane filter,

d) at least one outlet communicating with the center of said cylindrical membrane filter through at least one of said liquid tight seals to recover fluid filtered by said membrane filter,

e) said seal further comprising a liquid tight junction with a portion of the entire periphery of the inner surface of the housing.

24). The filter cartridge of Claim 23 wherein the membrane filter is a pleated membrane.

25). The filter cartridge of Claim 23 wherein said pleated membrane is supported by a perfluorinated thermoplastic fabric.

26). The filter cartridge of Claim 23 wherein the membrane is a microporous membrane.

27). The filter cartridge of Claim 23 wherein the membrane is an ultrafiltration membrane.

28). The filter cartridge of Claim 23 wherein an end cap is liquid tightly joined to each end of the housing.

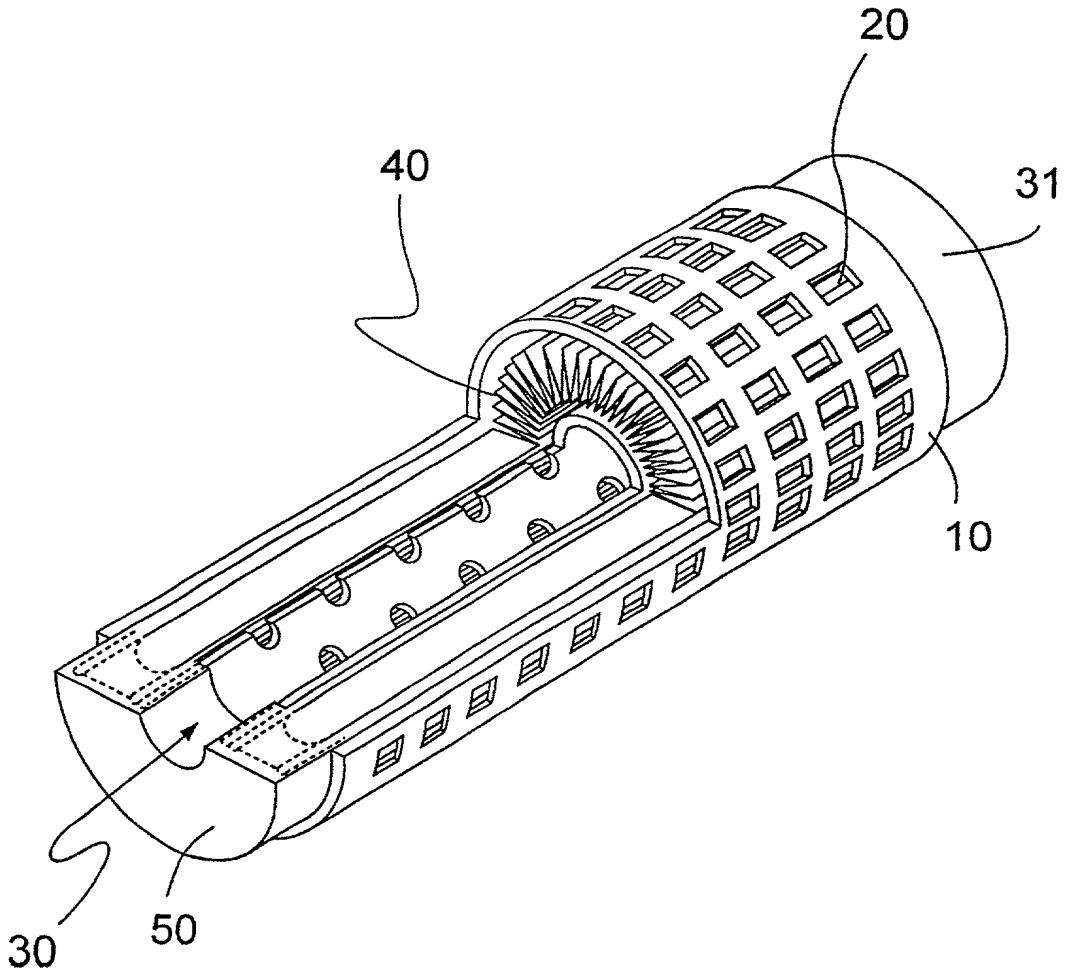

Fig.1

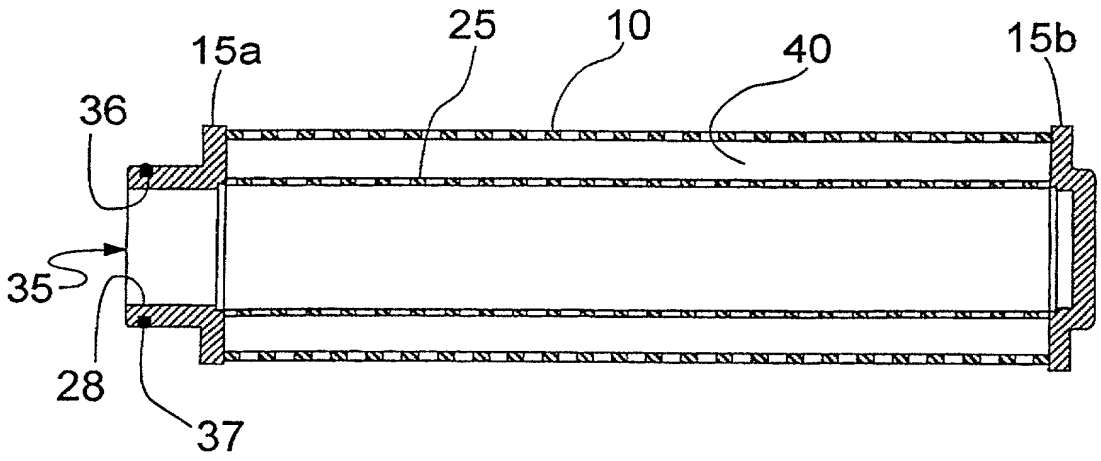

Fig.2

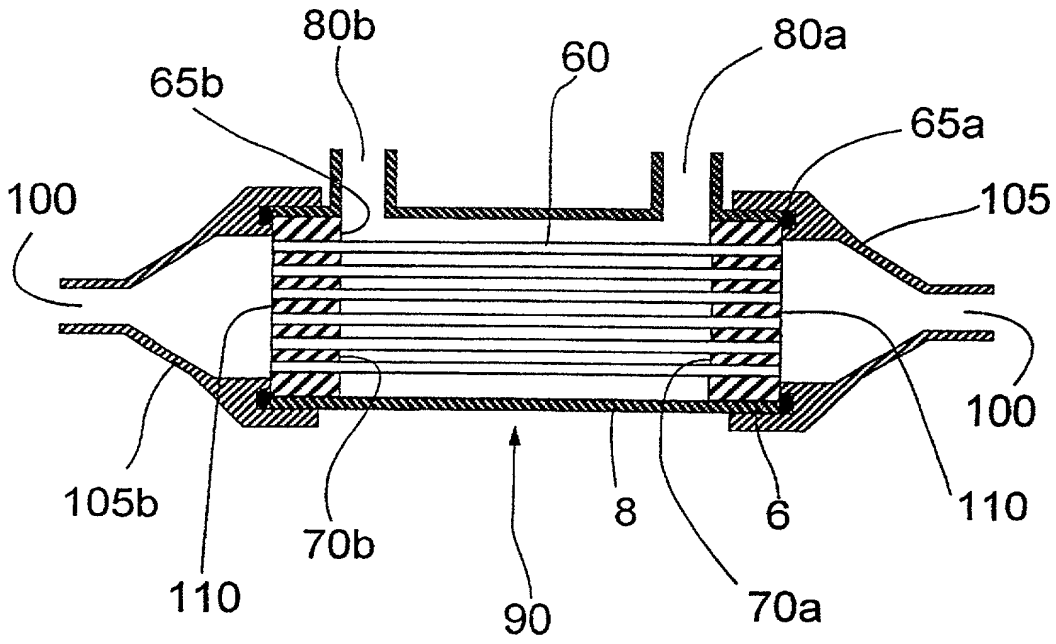

Fig.3

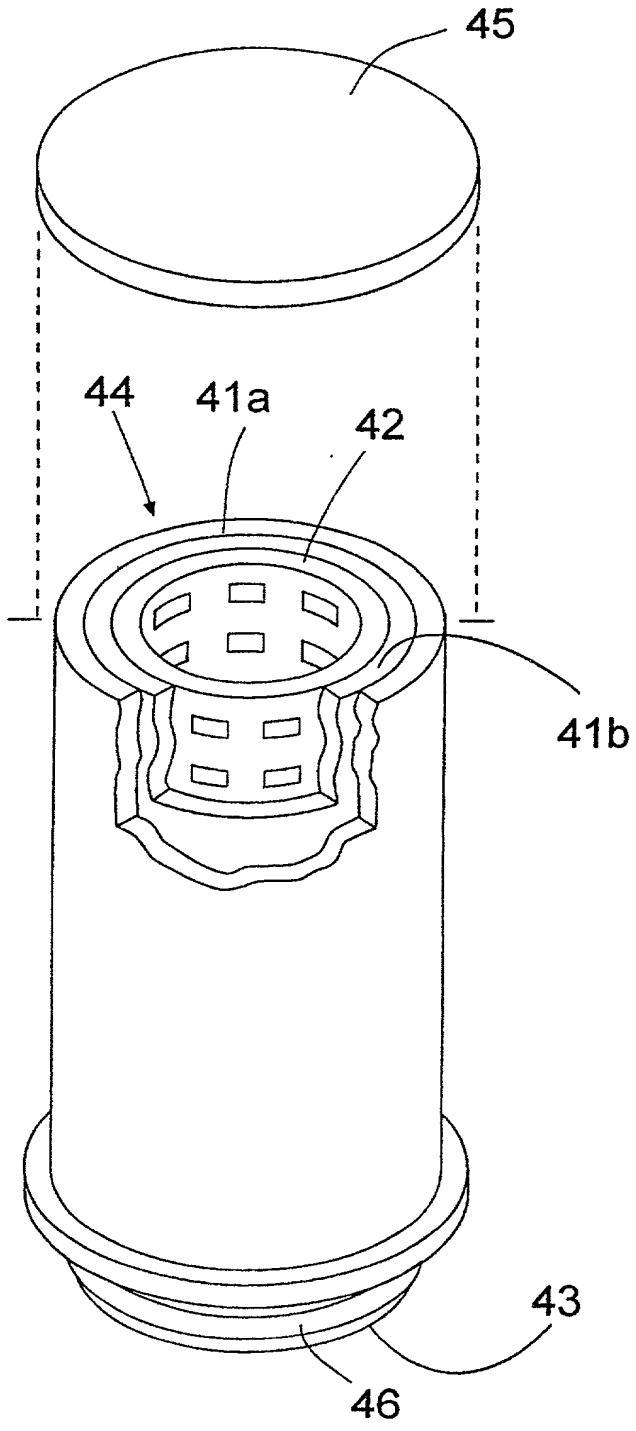

Fig.4

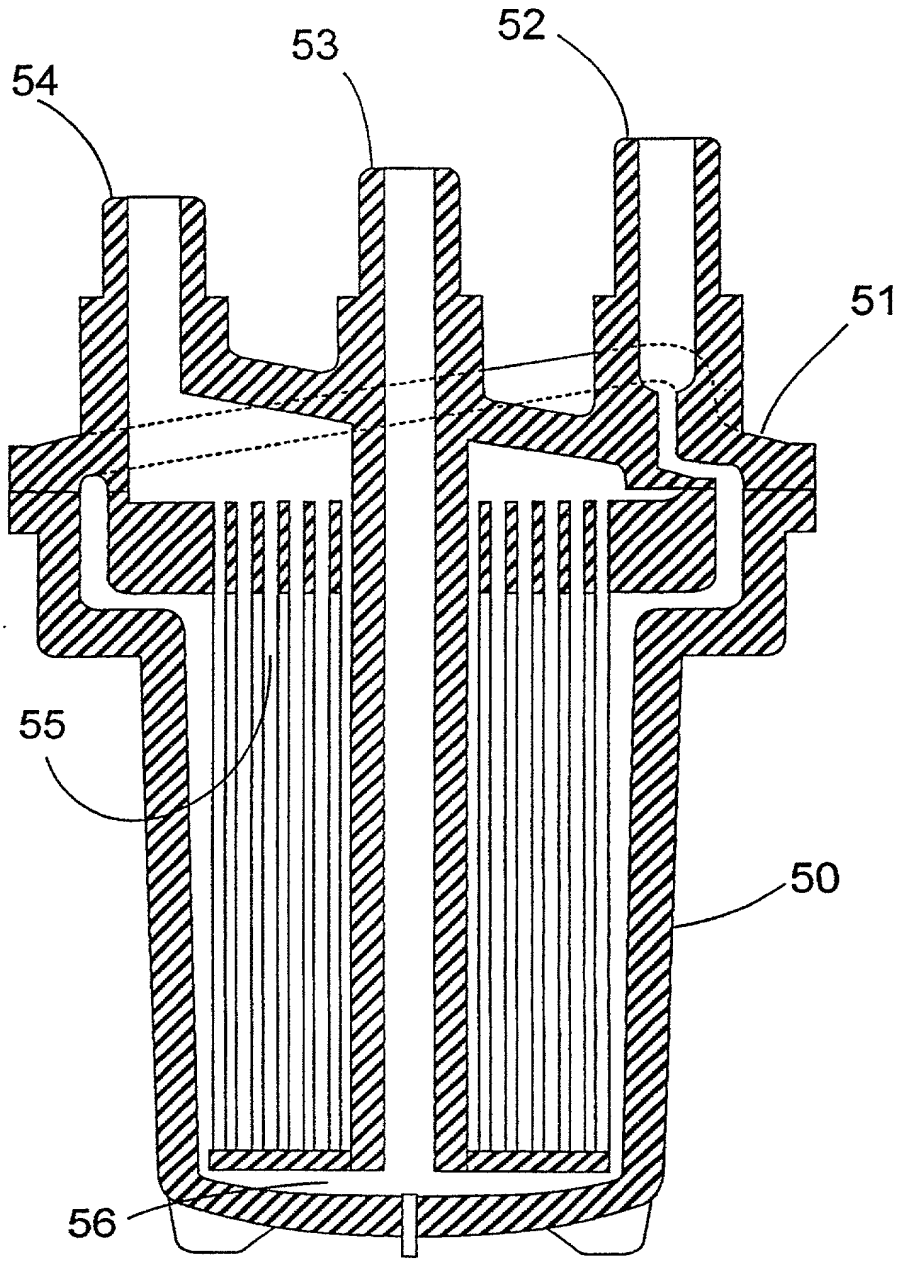

Fig.5

Docket No. MCA-437 PC/US

Declaration and Power of Attorney for Patent Application
English Language Declaration

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

"PERFLUORINATED THERMOPLASTIC FILTER CARTRIDGE "

the specification of which

(check one)

[ ] is attached hereto.
[x] was filed on 28 January 2000 as United States Application No. or PCT Application No. PCT/US00/02423
and was amended on _____ (if applicable)

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose to the United States Patent and Trademark Office all information known to me to be material to patentability as defined in Title 37, Code of Federal Regulations, Section 1.56.

I hereby claim foreign priority benefits under Title 35, United States Code, Section 119(a)-(d) or Section 365(b) of any foreign application(s) for patent or inventor's certificate, or Section 365(a) of any PCT International application which designated at least one country other than the United States, listed below and have also identified below, by checking the box, any foreign application for patent or inventor's certificate or PCT International application having a filing date before that of the application on which priority is claimed.

Prior Foreign Application(s)			Priority Not Claimed
_____ (Number)	_____ (Country)	_____ (Day/Month/Year Filed)	[ ]
_____ (Number)	_____ (Country)	_____ (Day/Month/Year Filed)	[ ]
_____ (Number)	_____ (Country)	_____ (Day/Month/Year Filed)	[ ]

I hereby claim the benefit under 35 U.S.C. Section 119(e) of any United States provisional application(s) listed below:

60/117,762 (Application Serial No.)	29 January 1999 (Filing Date)
(Application Serial No.)	(Filing Date)
(Application Serial No.)	(Filing Date)

I hereby claim the benefit under 35 U.S.C. Section 120 of the United States application(s), or Section 365(c) of any PCT International application designating the United States, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States or PCT International application in the manner provided by the first paragraph of 35 U.S.C. Section 112, I acknowledge the duty to disclose to the United States Patent and Trademark office all information known to me to be material to patentability as defined in Title 37, C.F.C., Section 1.56 which became available between the filing date of the prior application and the national or PCT International filing date of this application:

PCT/US00/02423 (Application Serial No.)	28 January 2000 (Filing Date)	Pending (Status) (patented, pending, abandoned)
(Application Serial No.)	(Filing Date)	(Status) (patented, pending, abandoned)
(Application Serial No.)	(Filing Date)	(Status) (patented, pending, abandoned)

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

POWER OF ATTORNEY: As a named inventor, I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith. *(list name and registration number)*

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